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Nursery Diseases of Southern Hardwoods

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Numerous diseases may be encountered in hardwood plantings in Southern nurseries. Although severe disease losses have been observed in only a few hardwood species, some loss occurs in nursery plantings of all species and can be expected to continue. The lack of an effective post-emergence herbicide to control weeds in hardwood nursery seedbeds and the high cost of handweeding has made preplanting soil fumigation—which controls not only weeds but also soil-borne diseases—a common and economically feasible practice in Southern nurseries (fig. 1). Although soil fumigation has reduced losses caused by a number of soil-borne disease pathogens, additional controls are needed for the relatively large number of other hardwood diseases which may be encountered.

It is beyond the scope of this publication to describe all nursery diseases of Southern hardwoods or give recommendations for their control. However, descriptions, causes, and general control methods for some of the more important nursery diseases of Southern hardwoods are included. The nurs-

¹ Plant pathologists, respectively at Southeastern and Southern Forest Experiment Stations, and Environmental Protection and Improvement, Southeastern Area, USDA Forest Service.

eryman is encouraged to contact a forest pathologist for diagnoses and recommendations for the control of specific diseases.

Damping-off

Damping-off is a widespread disease of forest tree seedlings caused by certain soil-borne fungi during early stages of seedling development. The damping-off pathogens most commonly encountered in Southern nurseries are *Fusarium solani*, *F. oxysporum*, *Rhizoctonia solani*, *Pythium sylvaticum*, *P. irregulare*, *P. ultimum*, *Phytophthora cinnamomi*, *P. cactorum*, *Sclerotium bataticola*, and *S. rolfsii*.

All Southern hardwood species are susceptible to damping-off. If the hypocotyl or epicotyl is attacked before the seedling emerges from the soil, pre-emergence damping-off occurs. Fungus injury of stem tissue near the ground-line after emergence results in post-emergence damping-off.

Both pre- and post-emergence damping-off may be caused by one or more of the listed fungi. Necrotic lesions on young seedling tissue are a characteristic symptom of damping-off, but this symptom may be confused with those of other diseases. Diagnosis

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Figure 1.—Preplant soil fumigation controls weeds and diseases: (A), Methylbromide-controlled damping-off, root rot, and weeds in sweetgum; (B), beds with no fumigant resulted in less plant density, no merchantable seedlings, and more weeds; (C), side view of above beds: to the left of irrigation riser, soil was fumigated, to the right, soil was not fumigated.

usually requires the isolation and identification of the pathogen.

The fungi that cause damping-off do not usually attack seedlings unless conditions for their development are favorable or conditions for the growth of seedlings are poor. Soil fumigants, such as

methyl bromide or Vorlex² (80-percent chlorinated C₃ hydrocarbons and 20-percent methyl isothiocyanate), will control damping-off. Drenching seedbeds

² Mention of commercial products does not imply endorsement by the U.S. Department of Agriculture.

with fungicides is of limited and temporary effectiveness. The following cultural practices will aid in the control of damping-off:

1. Planting at relatively low bed densities (10–20 per square foot).
2. Planting in well drained beds.
3. Planting in soil with a pH between 5.0 and 6.0.
4. Maintaining a relatively low level of available nitrogen during the first 6 weeks after spring seedling emergence.
5. Planting seed under enough mulch to conserve moisture and to promote the early development of deep seedling roots.

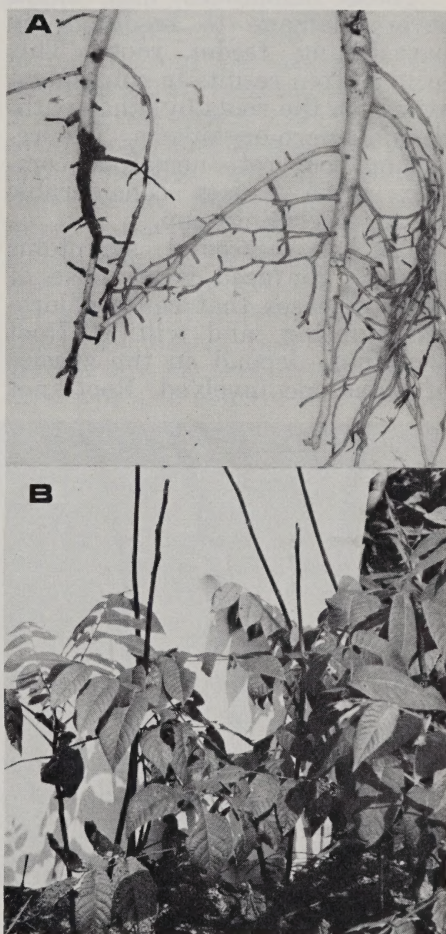
Root rot

Root rot is the most important disease of hardwoods in Southern nurseries. The pathogens most commonly involved are *Cylindrocladium scoparium*, *C. floridanum*, *C. crotalaria*, *Rhizoctonia solani*, *Pythium irregulare*, *P. sylvaticum*, *P. ultimum*, *Phytophthora cinnamomi*, *P. cactorum*, *Sclerotium bataticola*, *S. rolfsii*, *Fusarium solani*, *F. oxysporum*, and *Phymatotrichum omnivorum*.

In general, small feeder roots are the first to be attacked by the root rot fungi. The first noticeable symptom is discoloration and blackening of infected roots (fig. 2A). These roots die, and in severe cases, the disease progresses to include the larger roots. Above-ground symptoms include stunting, top dieback, chlorosis, and premature defoliation (fig. 2B). All hardwood species grown in Southern nurseries are susceptible to one or more root rot pathogens.

Soil fumigation with methyl bromide will control this disease, providing extra care is taken to

insure that the fumigant is applied under environmental conditions that maximize effectiveness. Although 435 pounds of methyl bromide per acre will control most root rot pathogens, adequate control of *Cylindrocladium* root rot requires at least 500 pounds per acre. Drenching with fungicides may provide some control of *Pythium* and *Phytophthora* root rots but is of limited and temporary effectiveness on most other root rots. The addition of organic matter to the soil, and the planting



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Figure 2.—A, Root symptoms of yellow-poplar infected with *Cylindrocladium* root rot; B, top symptoms of black walnut infected with *Cylindrocladium* root rot.

of resistant red cedar, oak, and certain monocotyledonous cover crops, will provide some control of *Phymatotrichum* root rot.

Nematode injury

The nematode species known to be pathogens on several Southern hardwood species are *Meloidogyne incognita*, *Pratylenchus penetrans*, *P. pratensis*, *Trichodorus christiei*, *Xiphinema chambersi*, *Hoplolaimus galeatus*, *Belonolaimus longicaudatus*, and *Helicotylenchus pseudorobustus*.

These nematodes may cause severe damage to seedlings by parasitizing feeder roots. This injury often results in subsequent attack on the roots by other pathogenic micro-organisms. The resulting root rot—nematode complex often causes considerable loss in a seedling crop.

The above-ground symptoms may be confused with those of other diseases that cause chlorosis, stunting, and wilting. Root symptoms depend on the species of nematode involved. Root-knot

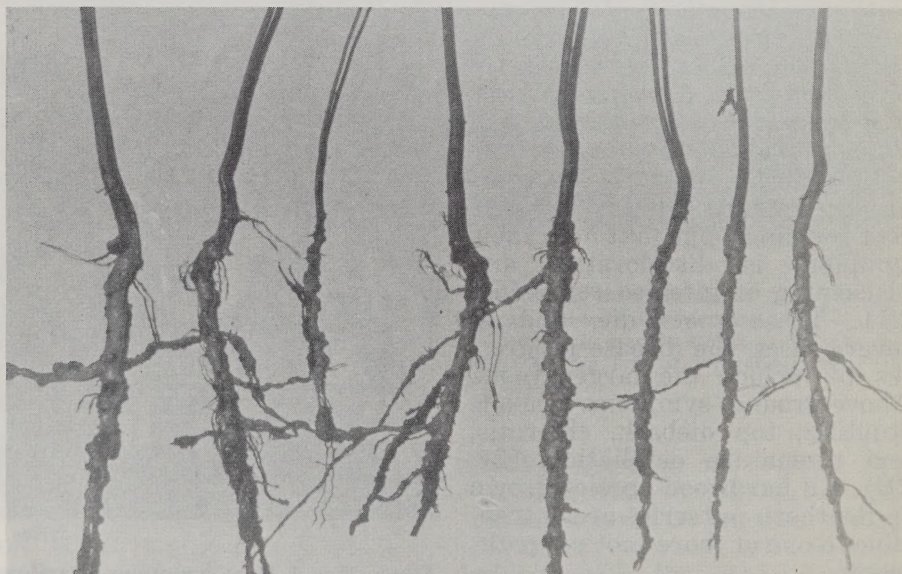
nematodes cause spheroid or spindly galls on large and small roots (fig. 3). Root-lesion nematodes cause necrotic lesions which resemble those initiated by certain fungi. Diagnosis of nematode injury usually requires the isolation and identification of the nematodes.

Although there are several nematicidal compounds available that are specifically for the control of nematodes, it may be desirable to use broad spectrum soil fumigants in areas where damping-off, root rot, or weeds are also a problem.

Dieback

The most frequently encountered fungi that cause dieback of hardwood species in Southern nurseries are *Cylindrocladium scoparium*, *C. floridanum*, *C. croatalaria*, *Botryosphaeria ribis*, *Diplodia natalensis*, and *Phomopsis macrospora*.

Among the important hardwood species, dieback is associated with the attack of *Cylindroclad-*



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Figure 3.—Symptoms of the root-knot nematode, *Meloidogyne incognita*, on catalpa.



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Figure 4.—Dieback symptoms on sweetgum caused by *Botryosphaeria ribis*.

ium on yellow-poplar and black walnut, *Botryosphaeria* on sweetgum (fig. 4), *Diplodia* on sycamore, and *Phomopsis* on cottonwood. The *Cylindrocladium* species listed cause dieback and root rot of yellow-poplar and black walnut. Depending on plant vigor and environmental conditions, dieback may cause the death of only a few shoot tips, a few seedlings, or an entire seedling crop. An early symptom of this disease is the presence of stem lesions with sunken areas at the base of stems or leaders. These lesions may be present on seedlings several weeks or months prior to the death of stems or leaders. Roguing infected plants, pruning infected plant parts, and spraying with certain fungicides provide some control of dieback.

Crown gall

Crown gall is caused by *Agrobacterium tumefaciens*, which in-

fects plants only through wounds. Black walnut, red oak, black locust, and hybrid poplars are the most important susceptible hardwood species. Galls, ranging up to several inches in diameter, are usually formed on stems at the groundline; they also occur on roots or aerial parts. The bacteria are most active during warm summer months, but do not survive more than 2 years in soil without a host plant and are less of a problem in acid than alkaline soils. The disease is controlled by rigidly excluding all infected vegetable, ornamental, and transplant material from the nursery. The planting of all infested areas for 2 successive years with resistant cover crops, such as oats, cowpeas, and crotonaria, will also control the disease. Since the bacteria must enter through wounds to cause disease, preventing man- and insect-made wounds on nursery stock will provide some control of the disease. Soil fumigation and certain bactericidal sprays or dips will also control the disease.

Anthracnose

Gnomonia veneta, *G. leptostyla*, *G. quercina*, and *G. ulmea* are the pathogens that cause anthracnose, a serious disease which results in defoliation and shoot mortality on several hardwood tree species. Anthracnose is most severe on sycamore, walnut, oaks, and elm during years with wet springs. Small circular to irregularly circular brown or black spots are early symptoms of the disease. Gradually these spots become more numerous, enlarge, and often merge to form large dead areas or blotches. Infected leaves or leaflets generally fall prematurely, but some infected foliage may remain attached to the tree for most of the season. Lesions on stems often develop into cankers with sunken, dark centers.

Because the fungus overwinters on infected twigs in large trees near the nursery and on fallen leaves, the burning of fallen leaves may provide some control of the disease. Certain fungicidal sprays also will give some control if applied during early spring as leaves are emerging.

Foliar diseases

The foliar diseases most frequently encountered in nursery plantings of Southern hardwoods are caused by *Phoma* spp., *Phyllosticta* spp. (leaf spot), *Septoria* spp. (leaf spot), *Cercospora* spp. (leaf spot), *Taphrina* spp. (leaf curl), *Erysiphe* spp. (powdery mildew), *Phyllactinia* spp. (powdery mildew), *Cronartium fusiforme* (fusiform rust), and *C. quercuum* (eastern gall rust).

Most of these diseases first appear during late summer or early fall and cause very little injury. However, early season infections by some of these pathogens will cause defoliation, severely reduce the size of planting stock, and reduce survival in outplantings.

The most common foliage disease on many hardwood species is powdery mildew. Damage consists primarily in stunted growth of foliage and twigs. This disease is easily recognized by the white, felt-like patches of mycelial growth on leaf surfaces.

Another common disease results from the infection of oak foliage in nursery plantings by *Cronartium fusiforme* or *C. quercuum*. These rust diseases are potentially serious problems in nurseries with both oak and loblolly or slash pine plantings. Orange pustules and brown, hair-like columns appear on lower surfaces of oak foliage. Although infections by these fungi seldom cause serious injury to oak, spores are produced by the hair-like telial columns which may

infect nursery plantings of pines and cause serious losses.

Because most foliar diseases that cause serious damage result from early season infection, the usual recommendations are for early application of fungicidal sprays that will control these diseases. However, the several foliar pathogens that infect seedlings during late season cause spots of various shapes, colors, and sizes, and may cause premature defoliation and reduce seedling survival in outplantings. A number of fungicides are available for the control of late-season foliar pathogens.

Caution — Improper handling, application, or disposal of methyl bromide, Vorlex, and other pesticides may be injurious to man, animals, and plants. Follow the directions and heed all precautions given by the manufacturer.

Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first-aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump or crush and bury them in a level, isolated place.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the Environmental Protection Agency, consult your local forest pathologist, county agricultural agent, or State extension specialist to be sure the intended use is still registered.

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